

Sept. 8, 1936.

O. E. CHEATHAM

2,053,601

METHOD AND APPARATUS FOR COATING PAPER

Filed Jan. 29, 1935

2 Sheets-Sheet 1

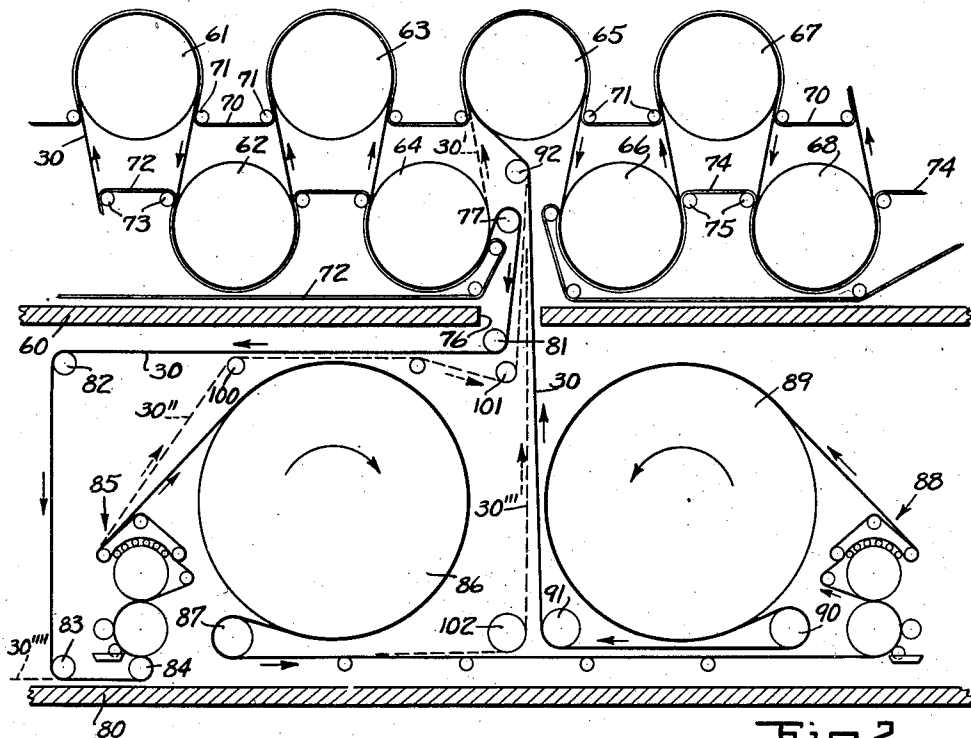


Fig. 2.

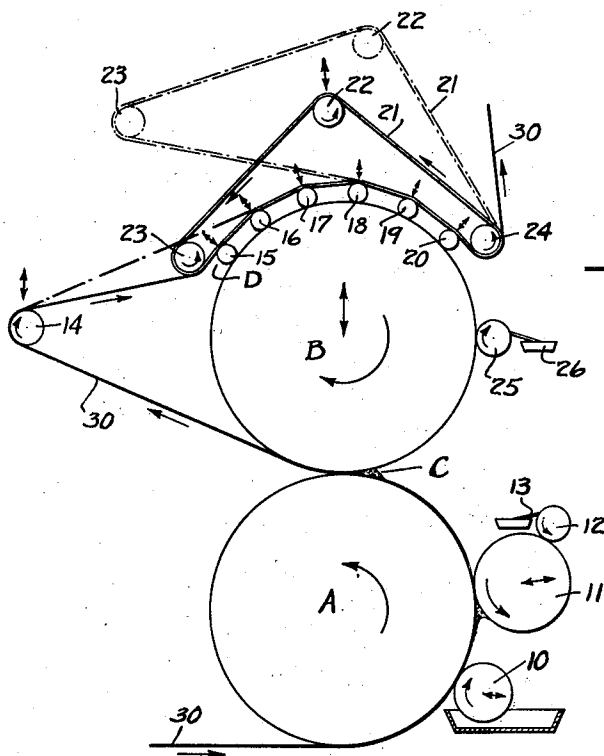


Fig. 1

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2 Sheets-Sheet 2

Fig. 3.

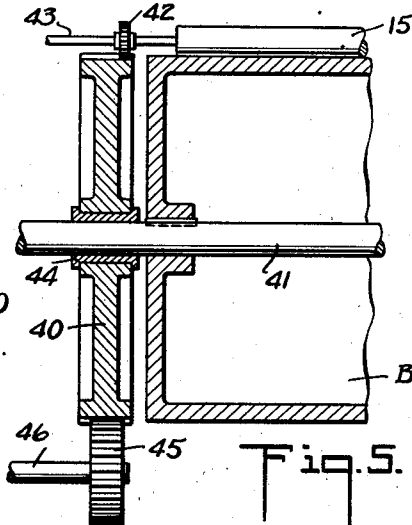
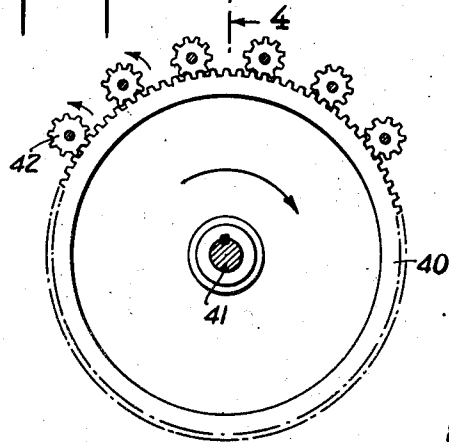


Fig. 4.

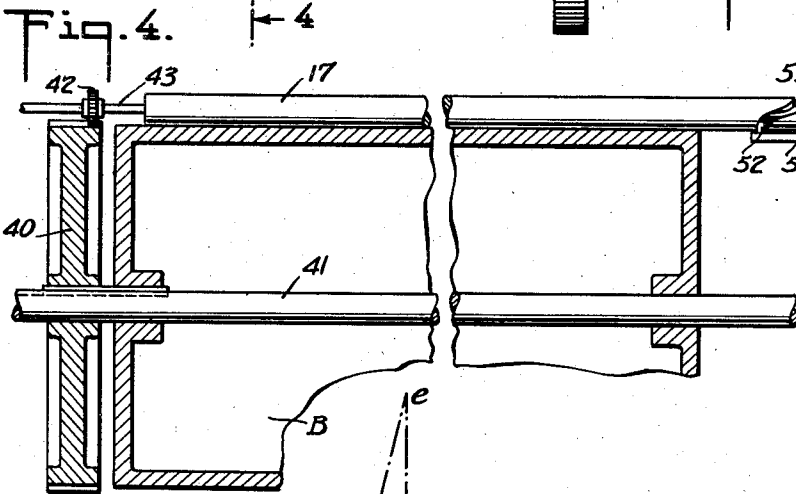
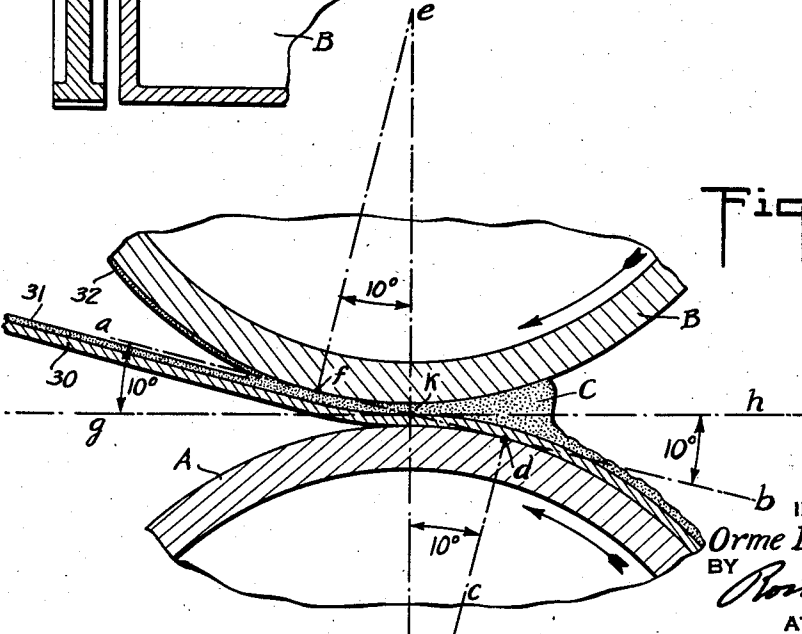


Fig. 6.



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METHOD AND APPARATUS FOR COATING PAPER

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Application January 29, 1935, Serial No. 3,924

13 Claims. (Cl. 92—38)

My present invention relates to a method and apparatus for coating paper with a coating designed to increase the printing qualities of the paper, to increase the opacity of the paper, and/or to color the paper. It is common practice to coat papers with some composition of an inert mineral, a liquid medium, and an adhesive or binder, in order that the paper shall be smooth and opaque and that printing inks will not be absorbed, whereby each printed character will be sharply defined and the printing on one side will not show through to obscure the printing upon the other side.

The primary object of my invention is to devise a method and apparatus whereby papers can be coated with a very light weight coating without there being defects in the surface of the coating.

It has long been possible to coat paper with a very heavy coating, but the present invention is designed for the manufacture of a light-weight coated paper, e. g., a paper having three pounds dry weight of coating on one surface of a ream (a standard ream being five hundred sheets each 25"×38", or a total of three thousand three hundred square feet of paper). A desired coating is thus in the range of about three pounds per three thousand three hundred square feet, or one pound of coating to one surface of one thousand one hundred square feet of paper.

A further object of the invention is to devise apparatus which is easily and quickly adjustable to maintain a desired weight of coating on various weights of paper, which have correspondingly varied thicknesses.

A further object of my invention is to devise a method and apparatus for coating paper whereby the coating material will be firmly bonded to the surface of the paper in order that the printing apparatus will not "pick" portions of the coating.

A further object of my invention is to devise an apparatus for coating paper which is quickly and easily adjusted to accommodate various thicknesses of paper, various types of paper, and to apply various thicknesses of the same coating, or to apply different types of coating, in order that any type of coated paper may be produced upon the same apparatus. One drawback of prior coating machines has been that each machine is designed primarily to apply a certain type of coating to a certain type of paper. The apparatus herein disclosed overcomes this object by providing a wide range of operating conditions in a single machine, whereby papers ranging from

light tissue paper coated with a light coating of thin composition to a very heavy paper coated with a very heavy coating of thick composition may be made. A wide range of operating conditions may be quickly produced in order that the operator may determine the best conditions to produce any one type of paper.

A further object of my invention is to provide means for coating one or both sides of a web of paper in the making process in order that the intermediate step of winding the web at the end of the existing paper making machine may be eliminated. In achieving this object of my invention I have devised a method and apparatus whereby the existing equipment need not be altered in such a fashion that the machine could not be used for making "machine calendered", "machine finished", or other uncoated papers.

A further object of my invention is to produce a method and apparatus for carrying out the last mentioned object wherein a paper as it emerges from the forming machine may be led through alternative steps to produce the following:

- 1.—Uncoated papers
- 2.—Papers coated on one surface; and
- 3.—Papers coated on both surfaces.

A further object of my invention is to devise an arrangement of apparatuses whereby the objects of the foregoing paragraph may be obtained in order that various types of papers may be manufactured in the making process, or alternatively, papers previously made by the existing paper machine may be coated in the same coating apparatus on one or both surfaces as a separate manufacturing process. Consistent with the foregoing, if the paper making machine should be idle, the coating can nevertheless be accomplished upon previously manufactured papers.

Other and further objects and advantages of my invention will be realized from a study of the following specification, taken in connection with the accompanying drawings wherein like numerals refer to like parts throughout. In the drawings:

Fig. 1 illustrates a preferred form of the apparatus for applying and smoothing the coating, the apparatus therein disclosed being used in conjunction with drying mechanism to dry the coating;

Fig. 2 discloses a preferred arrangement of coating mechanism and making machine for carrying out the foregoing objects;

Fig. 3 discloses a detail of the coating mechanism;

Fig. 4 is a section of the coating mechanism taken along line 4—4 of Fig. 3;

Fig. 5 is a partial section similar to Fig. 4 and illustrating an alternative arrangement; and

Fig. 6 is an enlarged detailed view of a portion of the coating apparatus and illustrating features of the process involved.

Referring to Fig. 1, my invention embodies two backing rolls, a lower roll A and an upper roll B. These rolls may be surfaced with soft or hard material, or one may be hard and the other soft, in accordance with the desired practice. For the universal use of my invention I prefer that both rolls A and B be "hard" rolls so that they may have true surfaces across the entire unsupported width thereof. The rolls are preferably large, i. e., thirty inches in diameter although it is not essential that they both should have the same diameter. The primary prerequisite of the rolls is that they should be capable of maintaining true surfaces across the entire width of the web. The ordinary, modern, high-speed making machine creates a web up to two hundred inches in width; for this reason the rolls must be rigidly constructed.

At 10 I have shown an applicator, which in the preferred embodiment consists of a roll partially submerged in a bath of coating material. This roll is adjustably mounted so as to vary the gap between it and roll A about which the paper web is passed. Roll A and roll 10 preferably revolve in opposite directions so that roll 10 easily transfers a layer of coating to the web. In carrying out my process it is intended that the applicator should apply more coating than is desired, but not much more.

At 11 there is shown a limiting roll, likewise adjustably mounted so as to be movable toward and from the web. Roll 11 is a hard-surfaced roll rigidly constructed so as to maintain a true surface across the width thereof. The nip of rolls 11 and A is fixed in accordance with the determined conditions so as to allow the thickness of paper being coated and a desired thickness of coating to pass therethrough. Roll 11 preferably rotates in the same direction as roll A, and since the web carries a slight excess of coating over that desired there will be a slight pool of coating formed at the lower or entering angle. The formation of this pool materially aids in causing the coating to be spread uniformly upon the surface of the web. The primary purpose of roll A is to insure that all excess coating will be brushed back. If there is a great excess some of it will drop down onto the surface of roll 10 and be returned into the applicator bath where it will be remixed and reused. A portion of the coating will be carried around roll 11 and will be removed by a cleaning device 12. I have illustrated the cleaning device as a roll 12 (which is preferably rubber-faced) against which is mounted a cleaning doctor conveying the removed coating material into a trough from which it may be salvaged. Various and sundry types of cleaning devices are well known and may be substituted for the roll and doctor, as long as the cleaning device operates to remove the film adhering to roll 11 so that excess coating material will not be carried back to the web.

The web, bearing substantially the desired amount of coating material, now passes between the nip of rolls A and B, roll B being vertically adjustable in its standards to accommodate the particular paper and thickness of coating. The rolls A and B rotate in opposite directions so that

their surfaces in engagement with the web move in the same direction. Even though the paper is now bearing substantially the desired weight of coating, there will be a slight pool of coating material formed at C.

The web is led from the nip of rolls A and B away from the surface of roll B and around a smoothing roll 14 rotating with the web. From this point the web is led into engagement with a secondary smoothing and bonding mechanism which will be described later.

Referring to Fig. 6, taken in connection with Fig. 1, it will be seen that in the use of my invention it is preferred that the distance between rolls A and B be such as to allow the web and the desired amount of coating material to pass therethrough. The web 30, passing around the roll A, brings up a layer of coating which, due to the reversely turning roll 11 and the very moist condition of the coating material, will be rippled and otherwise uneven. At C a pool of coating material is squeezed back, the pool varying in size from time to time. After the web passes the center-line of the rolls it will have had the coating material forced into the pores and between the fibres thereof to a certain extent, but a major portion of the material will remain on the surface of the web as a film 31. Due to the fact that the web is quickly led away from the surface of roll B, not all of the coating material will be bonded to the surface of the web and a portion of the coating material will adhere to the surface of the roll as a film 32. The cohesion of the coating material will cause an uneven splitting of its body so that ridges and uneven spots will remain in the coating applied to the web 30. Because the coating has not been in contact with the paper for any appreciable length of time (particularly at the normal making speed of six hundred feet per minute) not all of the liquid medium will be absorbed or evaporated and the portion of the coating material 32 which adheres to roll B will be in substantially its original state. Since the paper is rough and absorbent it tends to draw more of the coating material to its surface and the film 32 will be comparatively thin.

Line *a, b* is drawn tangentially to the surface of the two rolls, and lines *c, d* and *e, f* are the tangential radii. Line *g, h* is a normal to the center-line of the rolls, passing through the point of intersection, *k*, of the tangent and the center-line. The angle of tangency of roll A will always be equal to the angle of tangency of roll B regardless of the size of either roll and the distance between the rolls. Likewise, angles *a—k—g* and *h—k—b* will be equal to the angle of tangency. In this instance I have illustrated the angle as being about ten degrees. In carrying out the process of my invention roll 14 is preferably vertically adjusted for each setting of roll B in order that web 30 will be led away from roll B substantially at the angle of inclination of the tangent, or parallel to line *a, b*.

It can be seen that as the distance between rolls A and B is increased, the inclination of line *a, b* will increase, and to maintain web 30 parallel thereto roll 14 is to be raised. The reason for separating the rolls is to accommodate a thicker web and/or a thicker coating. Raising roll 14 will shift the point at which the coating composition tends to split into films 31 and 32 and will maintain the web in contact with roll B for a greater length of time. In this fashion practically the proportionate quantity of material will always be maintained in each film, and a propor-

tionate pressing of the coating material into the web will be maintained. In other words, to have the same operating conditions for any coating, or paper, it is merely necessary to adjust roll 14 so as to maintain the web parallel to the tangent to the rolls A and B.

At roll 14, the film 31 will be further smoothed and compressed into the web, particularly since the web has had considerable opportunity to absorb the liquid medium and the liquid medium has had some opportunity to thicken by evaporation of the liquid medium. Nevertheless, the web leaves roll 14 in a moist condition and its surface will be somewhat rough and rippled. In order that the utmost smoothness will be imparted to the coating before it has had an opportunity to set, the following mechanism is employed:

Mounted above roll B are a plurality of spaced smoothing rolls resting upon the upper surface of roll B. I have illustrated six rolls, numbered 15 to 20 inclusive, but any desired number may be used. The primary purpose of mounting these rolls in the manner illustrated is to support the rolls. Such rolls, being preferably not more than two inches in diameter, are self-supporting in short lengths, but for use in connection with a paper making machine must be at least eighteen feet in length and have heretofore been thought to be impractical because they could not be prevented from sagging. It has been suggested that such a roll could be supported at intermediate points but this is impractical since the supporting elements would create different surface conditions upon the rolls at various points throughout their lengths. By mounting the smoothing rolls so as to be supported by the roll B throughout their lengths it is insured that the same condition exists throughout any surface element of each smoothing roll.

In order that the web may be fed through the machine and maintained in contact with each of the smoothing rolls there is provided a driven felt 21 above the smoothing rolls. Felt 21 passes about rolls 22, 23 and 24, each of which is shiftable to a considerable extent. As illustrated in Fig. 1, if roll 23 is elevated to the position shown in dotted outline, roll 22 must be shifted to maintain tension upon the feeding felt. Such shifting would result in the portion of the web stretched between roll 14 and roll B to assume the dotted line position illustrated in Fig. 1 thereby throwing the web out of engagement with smoothing rolls 15 and 16. The web passes upward around roll 24, and shifting of roll 24, either with or independently of roll 23, will throw the web into or out of engagement with any combination of the smoothing rolls. By means of this simple adjustment any number of the smoothing rolls may be utilized, as determined to be best for each type of paper to be produced. Roll 22 is vertically adjustable in order to maintain proper tension upon the felt 21 so that the web of paper will be yieldingly pressed against the peripheries of the smoothing rolls. Rolls 15 to 20 inclusive are preferably adjustably mounted so that suitable frictional contact may be maintained with the surface of roll B, or that any one of the rolls may be shifted out of contact with the surface of roll B. It will be appreciated that the drawings illustrate a schematic embodiment of the invention, there being any number of specific mechanisms apparent to those skilled in the art.

It will be seen that the distance from point C around roll 14 to point D, where the web again approaches roll B, is appreciably greater than the

arc C—D. The film 31 is not only being absorbed by the web, but is pressed into the web and worked by roll 14 so that by the time the web approaches point D the film 32 will be considerably more plastic than the film 31. At point D, therefore, roll 15 is in engagement at one side with a film of coating material on the web of paper and on the diametrically opposite side with a moister film of coating material on the surface of roll B. The smoothing rolls are rotatable (Fig. 1) by their frictional contact with roll B and tend to rotate in the opposite direction to the web, particularly if they are adjusted to have a firm contact with roll B and felt 21 is slightly slackened. The reversely rotating smoothing rolls tend to wipe the partially coagulated coating on the web and smooth the same. However, the surfaces of the rolls are moistened by the film 32, and a quantity of the coating material is picked up and transferred around the surface of the coating roll to the web, thereby moistening and assisting to smooth the coating on the web. The material passing around the coating roll 15 travels in a closed cycle and the net effect is to moisten the coating and smooth the same to a great extent. The same process will be repeated at roll 16, only there will be less coating material upon the surface of roll B and more upon the surface of the web. In some instances it will be found that the kneading of the successive rolls will thicken the coating upon the web and work it in to such an extent that roll 20 will merely act as a last smoothing roll and will not have any moistening or other effect.

Regardless of the theoretical condition of the coating material at each instant (which, of course, would be difficult to observe because of the high speeds and the nature of the process), the apparatus used in the manner described produces a smoother, coated paper than heretofore possible, and uniformly coated papers of all classes may be manufactured. It will be appreciated that the bight of the web and the roll B may not have continuously smooth films thereon, such as films 31 and 32 illustrated, and in fact it is more than probable that the portions of the coating material on the roll and on the web will be rough, particularly if the desired coating is very heavy. Nevertheless, the final result is a smooth, coated paper.

Various types of paper, and various desired results, as well as various types of coating composition, may be experimentally determined to require various combinations of smoothing rolls. Thus, by shifting roll 23 to the position shown in dotted outline in Fig. 1, and by shifting rolls 15 and 16 from engagement with roll B, the point D will be shifted to roll 17 and there will be but four smoothing rolls in operation. Similarly, roll 24 may be shifted to such an extent that, point D remaining as it is, there will be but rolls 15, 16, 17 and possibly 18 in operation. Both rolls 23 and 24 may be shifted until only one, or none of the smoothing rolls will be in operation. Other conditions may be created by shifting rolls 23 and/or 24 while leaving all of the smoothing rolls in contact with roll B, thereby working and thickening the film 32 before it is brought into contact with the web and allowing a greater time for film 31 to be absorbed and thickened before being brought into contact with the smoothing rolls.

In order that a clean surface will be presented at point C roll B is preferably cleaned, as by

a cleaning roll 25, and a doctor blade and collecting trough 26.

It may be preferable, as previously explained, to rotate the smoothing rolls by their frictional engagement with roll B, but it may likewise be preferable to have the rolls driven in one direction or the other in order that positive rotation in a certain direction and at a certain speed may be obtained. In Figs. 3 and 4 there is illustrated a large gear 40 keyed to the shaft 41 of roll B for rotation therewith. Gear 40 meshes with a gear 42 keyed to the shaft 43 of each of the smoothing rolls. Each smoothing roll, therefore, will be rotated at a constant speed having a definite relation to the speed of the web and its surface bearing against the web will be travelling in a reverse direction to that of the web.

In Fig. 5, a further modification is shown wherein gear 40 is loosely mounted upon a ring bearing 44 carried by shaft 41. A gear 45 driven by shaft 46 meshes with and drives gear 40. Depending upon the direction of rotation of gear 45, the smoothing rolls can be made to rotate in either direction, and the speed of gear 45 may be varied so as to vary the speed of the smoothing rolls relative to the speed of travel of the web. Various speeds and directions of rotation may be found desirable for different operating conditions and desired results.

Regardless of the direction of rotation of the smoothing rolls, it is desirable to reciprocate the rolls longitudinally under some conditions. To accomplish this at least one bearing 50 of each smoothing roll may be supplied with an arm 51 carrying a pin 52 projecting into a slot 53 in the smoothing roll. The pitch of slot 53 determines the longitudinal movement of the roll. The effect of this device is to cause rubbing and further smoothing of the coating upon the web, and to prevent or break up uneven accumulations of the film upon roll B. In order to accommodate the longitudinal reciprocations of the rolls, gear 40 is relatively broad so that gears 42 will always remain in mesh therewith. In the assembling of the mechanism, the gear 42 of each roll may be brought into mesh with gear 40 at a relatively different position so that at any instant each pin 52 will be in a relatively different position in its slot 53, with the result that each smoothing roll may be travelling in a different direction, or at least will be at a different position.

The smoothing rolls may be made in any known fashion, for instance, they may be covered with a cloth, felt or other soft surfacing material, or may be hard-surfaced rolls, or may have a rubber coating adhered thereto. It is not my intention to claim any particular type of roll, either with respect to the smoothing rolls or any of the other rolls, since the invention is directed toward the mechanism arranged as illustrated, each roll being manufactured in accordance with the desired practice. It is my belief that, regardless of the surface characteristic of each roll in the mechanism, any type of paper having any type of coating can be manufactured, all that is necessary being experimentally to determine the proper setting of each element of the mechanism.

In order most effectively to utilize my coating mechanism, the arrangement shown in Fig. 2 is preferred. In this 60 represents the floor of the room in which the papermaking machine is located. 61 to 68, inclusive, represent conventional dryer drums located at the dry end of the papermaking machine. The drums are rotated by suitable mechanism and heated in the usual

fashion properly to dry the web 30 entering the dryer drums from the left of Fig. 2. Not all of the usual number of dryer drums are illustrated, there usually being twenty or more. In the arrangement illustrated, the upper tier of dryer drums have the web 30 held in engagement therewith by a driven dryer felt, or felts 70 passing around guide rolls 71. The lower tier of dryer drums have the web 30 held in engagement therewith by a driven felt 72 passing around guide rolls 73. It is customary, particularly in a long line of dryer drums, to have one or more dryer felts in each tier in order that undue stretching of the felt will be avoided and proper driving thereof can be achieved. Thus, in Fig. 2 the lower dryer drums 66 and 68 are shown as having a separate dryer felt 74 passing around guide rolls 75. The manner of driving the dryer felts and of passing the web through the dryer drums regardless of the number of dryer felts is well known. The ends of felts 72 and 74 are located between dryer drums 64 and 66, but it is a very simple matter to shift the position of any dryer felt to any point desired in any ordinary papermaking machine.

It is the purpose of my invention to allow the dryer drums to remain exactly as ordinarily mounted, since the framework and driving mechanism for the dryer drums is a very expensive and massive structure. At some intermediate point along the drums, when the web has received sufficient drying to be self-sustaining, I split the lower dryer felts and, adjacent the ends as illustrated, I create an opening 76 in the floor 60. Adjacent the dryer drum 64 there is a guide roller 77 around which the web 30 may be passed to a room below the making room. This arrangement is of extreme importance for several reasons, as follows:

1.—Ordinarily the paper mill has been designed to fit the type and size of machine desired, the usual arrangement being such that lengthening of the machine cannot be accomplished without rebuilding at least a portion of the mill.

2.—It is common knowledge that paper which has been completely dried and stored, ordinarily must be moistened before it can be successfully coated. It is a feature of my process that the paper when coated, while dried to the point of being strong enough to maintain itself, is not completely dried as it would be if passed through the entire set of dryer drums and is moist enough to be coated. In order to coat the paper at this point, it has been proposed to mount coating mechanism between sections of the dryer drums. One manner of accomplishing this is to pass the web upward above the top of the dryer drums. This is impractical because, first, the additional weight must be supported, secondly, the dryer drums are surmounted by a hood which is closely adjacent the upper drums and which conserves heat and causes complete drying with fewer drums, which hood would have to be removed for a considerable part of its extent in order to accommodate the coating mechanism and its mountings, and thirdly and most important, the terrific heat above the dryer drums makes it impossible for a man to be stationed in position to control the coating, and impossible for proper coating to be performed inasmuch as the heat coagulates the coating in the applicator and on the paper before it has had an opportunity to be smoothed. For these reasons the arrangement illustrated in Fig. 2 is considered of utmost value.

In the drawing 80 represents a floor below the

making room, upon which the coating mechanism is mounted. The web 30 is led around guide rolls 81, 82, 83 and 84 and into a coating and smoothing mechanism represented at 85 and constructed in accordance with the foregoing description thereof. As illustrated, there is mounted adjacent the coating mechanism a large dryer drum 86, preferably twelve feet or more in diameter, around which the web is passed for a greater portion of its circumference. The web is then passed around guide roll 87 into a second coating mechanism represented at 88 where the opposite surface of the paper may be coated and dried by a similar large dryer drum 89. It is then passed around guide rolls 90 and 91, back through the opening 76 to guide roll 92, and into the succeeding dryer drums in the making machine.

It will be observed in Fig. 2 that the side to which coating is applied at 85 is maintained out of contact with the surface of drum 86 and will have been dried sufficiently to prevent roughening thereof by the time it contacts the guide rolls. At 88 the opposite surface of the paper is coated and maintained out of contact with the drum 89, and the coating will have set before it comes in contact with guide roll 90.

The extreme advantage of this arrangement will be realized when it is seen that the web 30 may be passed from dryer drum 64 to dryer drum 65, as indicated at 30', in order that the production of ordinary paper may proceed. If passed to the coating mechanism, the web 30 may be coated on one side and thereupon passed around rolls 100 and 101 to the roll 92 and into the succeeding dryer drums, as indicated at 30'', if it is desired that one surface only of the paper be coated and that the large drums not be utilized. If only one surface is to be coated the web 30 may be passed from guide roll 87 around guide roll 102 and thence to the succeeding dryer drums, as indicated at 30'''. Any desired arrangement may be realized in the illustrated device.

The particular arrangement of the coating mechanisms relative to the large dryer drums 86 and 89 may be altered so as to place both coating devices between the dryer drums or to place only one between the dryer drums, or the coating mechanisms may be turned around so that the web 30 will be closely adjacent the dryer drums when it emerges therefrom. The illustrated arrangement is merely one possible manner of achieving the objects of my invention.

A further advantage of the invention will be apparent when it is realized that the coating mechanism may be maintained and operated entirely separately from the making machine, and a preformed web 30''' may be led into the coating mechanism and thereafter passed through the routes previously outlined. By this arrangement it is made certain that production of ordinary papers can be continued at the same time that the production of coated papers is achieved by utilizing preformed and stored rolls. In this way the mill laborers can be profitably employed during periods of mill shut-down.

A second advantage, it will be apparent, is that no expensive alterations are necessary in order that experiments may be carried on with the coating of paper as a step in the making process. And if, for the particular type of paper being manufactured, it is found impractical to coat the same as a step in the making process, the paper can be quickly re-routed into the succeeding dry-

er drums, rolled, and then coated as a separate process. This is of extreme importance since many types of paper are made at extremely high speeds, and it is conceivable that the coating of such papers must be conducted at much slower speeds.

I have illustrated preferred embodiments of my invention, but it will be apparent to those skilled in the art that alterations and modifications in detail and arrangement are possible, and I claim as my invention all such as come within the scope of the following claims.

I claim:

1. The process of producing coated papers comprising, applying more than the desired quantity of a coating material consisting of mineral matter, binder and liquid medium to a web of paper, immediately thereafter removing the excess quantity of coating material from the web, passing the web and the desired quantity of material between two adjacent rolls revolving with the web with one roll in contact with the coated surface and at such a distance from the second roll as to allow the passage of the web and the desired quantity of coating material, directing the web away from the nip of the rolls substantially parallel to the tangent to said rolls inclined toward the roll in contact with the coated surface so as to provide a film on said roll and a film on said web, directing the web back toward the surface of said upper roll opposed to the nip of said rolls, the length of the web so separated from the roll being substantially greater than the arcuate distance around the surface of the roll so as to permit greater coagulation of the film on the web than of the film on the roll, and simultaneously smoothing the film on the web and moistening the same by transferring thereto the film on the roll.

2. The process of producing coated papers comprising, applying more than the desired quantity of a coating material consisting of mineral matter, binder and liquid medium to a web of paper, immediately thereafter removing the excess quantity of coating material from the web, passing the web and the desired quantity of material between two adjacent rolls revolving with the web with one roll in contact with the coated surface and at such a distance from the second roll as to allow the passage of the web and the desired quantity of coating material, directing the web away from the nip of the rolls so as to provide a film on said roll and a film on said web, directing the web back toward the surface of said upper roll opposed to the nip of said rolls, the length of the web so separated from the roll being substantially greater than the arcuate distance around the surface of the roll so as to permit greater coagulation of the film on the web than of the film on the roll, and simultaneously smoothing the film on the web and moistening the same by transferring thereto the film on the roll.

3. The process of producing coated papers comprising, applying more than the desired quantity of a coating material to a web of paper, removing the excess quantity of coating material from the web, passing the web and the desired quantity of material between rolls revolving with the web and separated such a distance as to allow the passage of the web and the desired quantity of coating material, directing the web away from the nip of the rolls substantially parallel to the tangent to said rolls inclined toward the roll in contact with the coating material so as to cause division of the coating material into a film on said roll

and a film on said web, allowing the film on said web to become coagulated to a greater extent than the film on said roll, and simultaneously smoothing the film on said web and transferring thereto the film on said roll.

4. The process of producing coated papers comprising, applying more than the desired quantity of a coating material to a web of paper, removing the excess quantity of coating material from the web, passing the web and the desired quantity of material between rolls revolving with the web and separated such a distance as to allow the passage of the web and the desired quantity of coating material, directing the web away from the nip of the rolls so as to cause division of the coating material into a film on said roll and a film on said web, allowing the film on said web to become coagulated to a greater extent than the film on said roll, and simultaneously smoothing the film on said web and transferring thereto the film on said roll.

5. The process of producing coated papers comprising, applying a coating material to a web of paper, separating the coating material into a film carried by said web and a film carried by a moving surface, coagulating the film on said web to a greater extent than the film on said moving surface, and simultaneously smoothing the film on said web and transferring thereto the film on said moving surface.

6. The process of producing coated papers comprising, applying the desired quantity of a coating material to a web of paper, transferring a portion thereof to a travelling surface, coagulating the portion remaining on said web of paper to a greater extent than the portion on said surface, and simultaneously smoothing the portion on the paper and transferring thereto the portion on said surface.

7. Apparatus for producing coated papers comprising, opposed adjacently situated rolls revolving in opposite directions so that their adjacent surfaces move with a traveling web passed through the nip of said rolls, the web being passed around one of said rolls and into the nip of the rolls, means adjacent said roll to apply the desired quantity of coating material to said web, and means to direct the coated web away from the nip of said rolls in a direction substantially parallel to the tangent to said rolls inclined toward the roll adjacent the coated surface of the web.

8. Apparatus for producing coated papers comprising, opposed adjacently situated rolls revolving in opposite directions so that their adjacent surfaces move with a travelling web passed through the nip of said rolls, the web being passed around one of said rolls and into the nip of the rolls, coating means adjacent said roll to apply the desired quantity of coating material to said web, and means to direct the coated web away from the nip of said rolls in a direction substantially parallel to the tangent to said rolls inclined toward the roll adjacent the coated surface of the web, said coating means comprising an applicator

adjustable to apply more than the desired quantity of coating material and a limiting device comprising a roll having its surface next the web traveling in the opposite direction thereto to remove the excess quantity.

9. Apparatus for producing coated papers comprising, opposed adjacently situated rolls revolving in opposite directions so that their adjacent surfaces move with a travelling web passed through the nip of said rolls, the web being passed around one of said rolls and into the nip of the rolls, means adjacent said roll to apply the desired quantity of coating material to said web, and means to direct the coated web away from the nip of said rolls in a direction substantially parallel to the tangent to said rolls inclined toward the other roll adjacent the coated surface of the web, means to direct the web back toward the opposite surface of said other roll, smoothing rolls in contact with said opposite surface, and means to press the web against said smoothing rolls.

10. Apparatus for producing coated papers comprising, opposed adjacently situated rolls revolving in opposite directions so that their adjacent surfaces move with a traveling web passed through the nip of said rolls, the web being passed around one of said rolls and into the nip of the rolls, means adjacent said roll to apply the desired quantity of coating material to said web, and means to direct the coated web away from the nip of said rolls, means to direct the web back toward the opposite surface of said other roll, smoothing rolls in contact with said opposite surface, and means to press the web against said smoothing rolls.

11. The method of producing coated papers comprising, applying a film of the desired quantity of coating material to a web of paper, splitting said film into two portions, one of which remains on said web, setting the portion on said web to a greater extent than the other portion, and reuniting the two portions as a smooth film on said web.

12. The method of producing coated papers comprising, applying a film of the desired quantity of coating material to a web of paper, splitting said film into two portions, one of which remains on said web, setting the portion on said web to a greater extent than the other portion, and simultaneously smoothing the portion on said web and transferring said other portion to said web.

13. Apparatus for coating papers comprising means to apply a liquid coating to the surface of the paper, a large roll against which the moist, coated surface of the paper is brought in contact at one side thereof, a plurality of smaller smoothing rolls supported by said large roll on the other side thereof and against which the coated surface of the paper is subsequently brought into contact, and a traveling felt pressing the paper against said smoothing rolls.

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